

PHOSPHORUS RETENTION CAPABILITY
OF GRANULAR SOILS ON A PORTION
OF THE PRECAMBRIAN SHIELD

1975



Ministry
of the
Environment

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ONTARIO MINISTRY OF THE ENVIRONMENT

PHOSPHORUS RETENTION CAPABILITY

OF GRANULAR SOILS ON A PORTION

OF THE PRECAMBRIAN SHIELD

1975

by

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Technical Support Section
Southeastern Region
1975.

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Index	Page
Abstract	(ii)
Acknowledgements	(iii)
Background	1
General	5
Conclusions	13
Recommendations	13
Bibliography	14

Tables

Table I - Comparison of Pit Samples With Shallow (B Horizon) Samples Taken in the Same Vicinity.	10
Table II - Difference in Phosphorus Retention of Soils with Depth	11

Annexes

Annex A - Soil Sampling Procedures for Phosphate Analysis of Soils	15
Annex B - Laboratory Procedures for Phosphate Analysis of Soils	18
Annex C - Soil Samples Taken in 1974	25
Annex D - Soil Tests Conducted in 1975	29
Annex E - Location Map	

ABSTRACT

Tests to determine the phosphorus retention capability of soil were conducted in 1975 on a limited number of lots on sensitive recreational lakes and on pits from which material would be taken for the construction of raised tile beds. These were all located in the Precambrian Shield. The results indicated that the soil on the shoreline lots generally has a reasonable phosphate retention capability. The main limitation is the shallow depth of soil. The results indicate that tile beds in the area studied should be set back 100 ft. from sensitive lakes. The testing of borrow pits indicated that generally the pit material is too coarse and has a poor phosphate retention capability for use for raised tile beds on lots with a limited depth of soil. In the area tested there was suitable material overlying the main pit deposits.

The phosphate retention capability depends on the chemical composition of the soil. In granular material the sesqui oxides deposited in the B soil horizon have the best capability (generally the top two feet under the topsoil).

III

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BACKGROUND

Historical data on water quality in recreational lakes is sparse and incomplete. However, it appears that there is a relationship between density of development on the lakes and deterioration in water quality. The effects of removal of vegetation, disturbance of the soil by construction of roads, buildings and services, the "improved drainage" by accelerating runoff from swamps and natural settling basins, improperly designed or improperly operated waste disposal systems, and lakeside human activities all have some adverse affect on water quality in the lakes. The extent to which each activity is responsible has not been determined and will vary with local conditions.

A joint MOE/MNR Regional Committee was formed in 1974 in the Southeastern Region. This committee recommended a number of lakes for water quality survey, based on a number of factors including reported deterioration in water quality, importance of sports fishery, and pressures for development. Data has been collected on 48 lakes to permit an assessment of the lake capacity for development using the formula developed by Dillon (1) and the assessment of the results will be completed by early spring. 1976.

The joint MOE/MNR Regional Committee recommended that a number of precautionary measures be taken for new development on all recreational waters in the Southeastern Region. This is being implemented only on those lakes where there is concern over maintaining an adequate water quality for recreation and where this concern can be

¹ A Manual for Calculating the Capacity of a Lake for Development - Ministry of the Environment - March, 1975.

substantiated by measurements and calculations. The additional protective measures recommended are:

- (a) Set back of 100 feet as a buffer zone for the cottage and waste disposal systems.
- (b) Preservation of the natural vegetation between the cottage and the lake in the buffer zone.
- (c) The use of a tile bed with selected material with a good phosphate retention capability and the use of a siphon or pump to provide an even distribution of septic tank effluent to the tile bed.

The proposal put forward by the Joint Committee for engineered tile bed systems combined with a 100 foot set-back requirement for the primary structure (cottage) and waste disposal facility is intended as a total package for limiting phosphorus export from a cottage lot to sensitive recreational lakes. The tile bed system would be designed to ensure nutrient containment of the domestic wastes and the 100 foot buffer zone is intended primarily to limit the nutrient export associated with surface drainage, (ie. roof runoff, roads, parking space and soil disturbed during construction of the dwelling and waste disposal facility). As a secondary consideration, the 100 foot buffer zone of undisturbed soil mantle would provide an added margin of protection in the form of phosphorus retention for nutrients which might leave the tile field.

As a further factor, the Ministry is now being asked to consider the total environmental implications of proposed land use activities. The proposed 100 foot set back for the primary dwelling and waste disposal facility would ensure that now cottage lot development

would blend harmoniously with the environment thereby protecting the lake's aesthetic quality and at the same time provide a buffer for the cottages against noise pollution from outboard motor activity.

In a septic tank waste disposal system, there are four areas in which phosphorus may be prevented from reaching the lake.

- (a) Removal within the septic tank. This method is still experimental. However, the Pollution Control Planning Branch advise that the method appears promising.
- (b) Removal in the weeping bed. The soil can be tested in the weeping bed for P retention and provided there is even distribution of the effluent, the P retention capability can be estimated.
- (c) Removal in the soil between the weeping bed and the lake. P retention of the soil can be calculated but the even distribution cannot be assured. The effluent may fan out below the weeping bed or it may be restricted by the topography. It may get into fissures in the underlying rock and pass through a very limited amount of soil before reaching the lake.
- (d) Use by plants and trees. The use of phosphates by plants between the weeping bed and the lake can be significant during the growing season. It is difficult to calculate as the cover varies on every lot. Measurements of the use of phosphates by plants in locations where spray irrigation is practiced show an excellent removal capability of the order of 99%.² Of course part of this is recycled into the forest floor in the

² Penn State Studies No. 23 Waste Water Renovation & Conservation, Pennsylvania State University, 1967. Table 5, Page 37.

form of twigs and leaves. While there is no direct correlation between P removal with effluent sprayed on the surface and sub-surface sewage disposal, nevertheless, a significant portion of phosphorus could be expected to be removed if it is in the root zone.

It appears therefore that phosphate adsorption in the weeping bed is the most significant since it is assured. However, removal between the weeping bed and the lake by the soil and by plant growth can be significant. It would be desirable to have total phosphorus containment but this is not possible in many Precambrian soils. The next best would be to have phosphorus containment for the life of the cottage - say 50 years. In view of the new developments such as P removal by additives in septic tanks, perhaps this is too restrictive. An assured life expectancy of 25 years in the weeping bed and a total probable life expectancy of 50 years including probable retention between the tile bed and the lake is more reasonable.

Studies were conducted by Brandes³ on four lots where septic tank systems have been in use for a number of years. The soil on three of these lots had a high proportion of silt and clay and showed excellent phosphorus retention capabilities. On the fourth lot the soil was a sand with some gravel and silt and is probably not too unlike some of the granular soils tested in the Southeastern Region. In this soil the estimated retention of phosphorus was

³ Brandes, M; Studies on Subsurface Movement of Effluent from Private Sewage Disposal Systems Using Radioactive and Dye Tracers part 2, 1973/74; Pollution Control Branch, Ontario Ministry of Environment, 1975.

78%. As in the other lots most of the phosphorus was retained in the upper layers of the soil below the tilefield. The average concentration of phosphorus in the ground water in a control hole was 0.15 mg/l. At a distance of 10 feet from the tile bed in the direction of ground water movement the concentration was 0.93 mg/l and in two test holes located a distance of about 50 ft. and 60 ft. from the edge of the tile bed, the average concentration was 0.23 mg/l. However, concentrations in the groundwater were as high as 0.37 mg/l at a distance of 65 ft. Thus, to ensure almost complete retention of phosphorus for cottages located on lakes sensitive to nutrient enrichment and having granular soil, it would be necessary to increase the distance of the tile bed from the lake to above the minimum 50 ft. set back requirement.

GENERAL

In 1974/75, 20 soil samples from the Southeastern Region were analysed for phosphorus adsorption by the Applied Sciences Section, Pollution Control Planning Branch. These tests were performed on the fraction passing 200 mesh (silt-clay fraction). By 15 September 1975, 57 additional samples had been collected and analysed by the regional Laboratory. These samples were collected as follows:

Proposed lots for development - 18

Reconnaissance for raised tile bed material - 14

(Shallow deposits on subdivisions)

Testing existing borrow pits - 25

Total - 57

The analyses were performed in accordance with instructions and briefing provided by the Applied Sciences Section, Pollution Control Planning Branch.⁴ The samples were sieved and grain size distribution curves prepared. The phosphorus retention capacity of the soil is dependent on precipitation with carbonates and precipitation or adsorption by iron and aluminum oxides and clay minerals.⁵ These minerals are normally found in the finer fraction of soils which also presents a much larger reactive surface than coarser material. At the start of the program only the material passing 200 mesh was analysed for phosphorus retention. However, most samples had a high proportion passing 50 mesh and it was found that the portion between 50 and 200 mesh in many cases had a significant phosphate retention capacity, thus the procedure was altered to obtain the phosphorus retention for all materials passing 50 mesh. Generally samples which were primarily silt or clay have been avoided since these would have a good phosphate retention capability but would lack the necessary permeability.

The field procedures for sampling are contained at Annex A and the laboratory procedure is outlined at Annex B.

All samples taken in 1975 were from the Precambrian Shield area and most are from the vicinity of Bobs and Sharbot Lakes which are considered to be sensitive lakes. The following general

⁴ Chemical Analysis for Evaluation of Soil Adsorption Properties Research Paper No. S2040, Applied Sciences Section, Pollution Control Planning Branch, Ministry of Environment, October 1974.

⁵ Lee, G.F., Problems of Land Disposal of Domestic Waste Water 4th Environmental Engineering Conference, Montana State University, Bazeman, February, 1973.

observations are of importance:

1. The soil in Bobs and Sharbot Lakes is an average of 18 inches to 2 feet in depth.
2. The average phosphorus retention capability for all shoreline lots having granular soil with less than 40% silt/clay fraction is 10.7 mg/100 grams (1.07×10^{-4} grams/gram).

The number of lots tested is small and may not be entirely representative, however, it does indicate the general condition in the area tested. If an average lot with seasonal occupancy, 18 inches of soil and 100 ft. set back for the weeping bed is considered, then the life expectancy for P retention capability of the soil between the lake and the weeping bed can be calculated.

(a) P load = $.69 \times .8 = .552$ kilograms per year.

(step 14 of reference 1)

(b) P retention. Assuming even distribution from a 50 ft. tile bed and that 50% of the soil will be utilized in a rectangular area below the tile bed then the weight of soil involved is equal to $\frac{50 \times 100 \times 1.5 \times 50}{2} \text{ kg.} = 18.75 \times 10^4 \text{ kg.}$

P removal capability = $18.75 \times 10^4 \times 1.07 \times 10^{-4} = 20.06 \text{ kg.}$

Estimated life expectancy = $\frac{20.06}{.552} = 36 \text{ years}$

Thus the soil mantle has an acceptable phosphate retention capability providing there is a 100 ft. set back. This is contrary to the belief by some that soil in the Precambrian Shield is too coarse for good phosphorus removal. Of course there will be locations where there are coarse beach deposits or coarse stream

deposits which have a poor phosphorus retention capability. The more general problem is the shallow depth of soil and the uncertainty of the path through it to the lake. Thus, the important area is the tile bed itself through which the effluent must pass and for which the material has to be imported in nearly all cases. Pits used to obtain soil for tile beds were examined. Most sand/gravel (borrow) pits contain material which is too coarse and which has a poor phosphate retention capability. They are generally fluvio-glacial deposits which have been laid down by major streams and are generally quite clean with a low proportion of silt and clay. The material is very variable as can be expected from stream deposits. Channel samples of working faces almost invariably yielded a very low phosphate retention capability; however, examination in most cases revealed the top two feet of material was finer and had been subjected to additional weathering with the action of percolating surface waters.

In 1974 samples were taken from 10 borrow pits (Annex C). The samples were channel samples taken from parts of the pits exhibiting the finest material. The majority of these samples had a low silt/clay content and showed a poor phosphate retention capability. The Mosson pit at Steenburg Lake showed a striking difference in phosphorus retention with depth and this was confirmed with further sampling in 1975. (Annex D) The No. 1 Subdivision access road borrow pit showed a good phosphorus retention capability. However, it was a shallow pit and was not a major deposit as were the remainder of the pits sampled.

In 1975, sampling of pits was conducted with the purpose of finding suitable material and not for the purpose of proving that the pits were unsuitable. Consequently only the portion of faces with appreciable fine material were sampled. In spite of the selective sampling, a number of low phosphorus retention values were obtained. These are compared with relatively good phosphorus retention capability of shallow soils in the same pit or vicinity as shown in Table I.

Soil profiles are shown in photographs at Annex A. Surface soil, in the "A" horizon normally contains considerable organic matter. This horizon has had the greatest leaching by percolating surface waters (in many borrow pits this material is stripped and removed by the operator). Some of the dissolved minerals from this zone are precipitated in the "B" horizon immediately underneath as products of weathering such as kaolin and limonite. Under the B zone, is the parent material or "C" horizon which has been affected very little by surface waters. It is the "B" horizon which has the greatest phosphate adsorption capability. In the test area this zone commences between 6" and 2' below the ground surface and is generally 18" to 2' in thickness.

The following results serve as illustrations:

TABLE I

COMPARISON OF PIT SAMPLES WITH SHALLOW
(B HORIZON) SAMPLES TAKEN IN THE SAME VICINITY

LOCATION	PIT SAMPLE			B HORIZON SAMPLE			REMARKS
	Sample Number	P Adsorption mg/100g	Depth	Sample Number	P Adsorption mg/100g	Depth	
Mossons Pit	5006	1.40	Channel over 15.5 ft.	5004	7.50	18"	
Cox Pit	5013	1.00	Channel over 6'8"	5015	9.20	2'	
Moss Pit (North)	5077	9.03	Channel sample over 90"	5074	17.75	1'	5074 & 5077 are on the same face (the main pi was judged to be too coarse #5029)
Barr's Pit	5049	6.24	Channel sample over 7'	5089	9.48	18"	The main face was too coarse and was not sam
Hern's Pit	5056	3.55	Channel sample over 4'4"	5094	12.48	18"	The main face was too coarse and was not sam
Oconto Pit	5080	5.38	Channel sample over 62"	5082	7.87	2'	

TABLE II Difference in Phosphorus Retention of Soils
With Depth

Location	Soil Profile	Sample Depth	Sample No.	Color	P/Adsorption mg/100g
Back hoe hole 1	A Horizon 6" Topsoil				
Noel Subd. Sharbot Lake	B Horizon 24" sand with some silt/clay & a trace of gravel	18"	5065	brown	9.25
	C Horizon 30" sand with some silt/clay, trace of gravel & boulders	36"	5068	grey	2.44
Back hoe hole 2	A Horizon 6" Topsoil				
Noel Subd. Sharbot Lake	B. Horizon 24" sand with some silt/clay & a trace of gravel	18"	5067	lt. brown	8.14
	C. Horizon 30" sand with some silt/clay, trace of gravel & boulders	36"	5068	grey	2.44

These results point up three considerations:

- (a) In granular soils there is frequently a clear color differential between the iron stained B horizon and the unaltered C horizon which is frequently grey in color. This color distinction may be useful in selecting material with a good phosphorus retention capability. The colour distinction however, should be used with caution and only with granular material as clay minerals are grey in color and have a good phosphorus adsorption capability.
- (b) The effluent from the raised tile beds placed on top of existing shallow soil will pass through the B horizon, whereas the distribution tile on lots with 5 ft. of soil might be placed beneath it.
- (c) Soil from the B horizon is available at most borrow pits and can be used for raised tile beds.

Soil for raised tile beds can be selected from material with a minimum P adsorption capability of 6 milligrams per 100 grams.

A calculation for P adsorption in the tile bed is as follows:

Assume 18 inches of native soil and 18 inches of imported soil below the tile bed.

P load = .552 kg per year

Assuming 4 -50 ft. tile runs, 6 ft. centre to centre (bed width 24 ft.) even distribution and 3 ft. of material below the tile then weight of soil involved

$$= 50 \times 24 \times 3 \times 50 = 1.8 \times 10^5 \text{ kg}$$

P removal capability of 18 inches of native soil = 10.7×10^{-5} grams per gram (g/g)

18 inches imported soil = 6×10^{-5} g/g

Average = 8.3×10^{-5} g/g

P removal = $1.8 \times 8.3 = 14.9$ kg

Estimated life expectancy = $\frac{14.9}{.552} = 27$ years

Results of tests are tabulated as follows:

Annex C - Soil samples taken in 1974

Annex D - Soil tests conducted in 1975

Annex E - Location Map

CONCLUSIONS

1. Within the area tested the soil mantle generally has a good phosphate retention capability but it is limited by the amount of soil present.
2. Present material being used for raised tile beds comes from major sand/gravel pits and is too coarse. It has a poor phosphate retention capability.
3. Suitable material is available at most major deposit sites. Generally it is the top two feet of the material.
4. Further testing is necessary to see whether these conclusions have general application to the whole of the Canadian Shield.

RECOMMENDATIONS

1. That further soil tests be performed to confirm these conclusions over a wider area.
2. That the 100 ft. set back for waste disposal systems be maintained on all sensitive lakes in the Southeastern Region.
3. That the material for raised tile beds for use on sensitive lakes be tested and only that material having phosphorus removal capability greater than 6 mg/100 grams be used.
4. That the soil testing program be expanded next year to provide data on all borrow pits from which material is being

used for tile beds on known sensitive lakes. Field test techniques are outlined at Annex A and could be followed by Municipal and Private Abatement Section in a more comprehensive program in support of the Recreational Lakes Program.

BIBLIOGRAPHY

1. A Manual for Calculating the Capacity of a Lake for Development - Ministry of the Environment - March, 1975.
2. Penn State Studies No. 23 Waste Water Renovation & Conservation, Pennsylvania State University, 1967. Table 5, Page 37.
3. Brandes, M; Studies on Subsurface Movement of Effluent from Private Sewage Disposal Systems Using Radioactive and Dye Tracers Part 2, 1973/74; Pollution Control Branch, Ontario Ministry of Environment, 1975.
4. Chemical Analysis for Evaluation of Soil Adsorption Properties Research Paper No. S2040, Applied Sciences Section, Pollution Control Planning Branch, Ministry of Environment, October 1974.
5. Lee, G.F., Problems of Land Disposal of Domestic Waste Water 4th Environmental Engineering Conference, Montana State University, Bazeman, February, 1973.

Annex A to Phosphorus Retention
Capability of Granular Soils
on a Portion of the Precambrian
Shield

Soil Sampling Procedures for Land
Development on Sensitive Lakes

General

The samples tested must be truly representative. If there are several different soils involved then several samples will be required. However, the number of samples must be kept to a minimum because of the laboratory testing work load.

Lot Sampling

If there is sufficient soil on the lot (minimum 5 feet) then a sample hole should be dug by the developer to a depth of 5 ft. in the tile bed area. A representative sample should be taken at a depth of 2 ft. If there is a change in the soil type, a further sample may be taken at greater depth. The soil between the tile bed and the lake should be examined. If it is similar to that in the tile bed, no further samples need be taken. If there is insufficient soil on the lot then a sample should be taken below the topsoil in the B horizon (see photo 5) at a depth of 1 - 2 feet in the tile bed area.

Pit Sampling

In the event that a raised tile bed has to be constructed then imported material should be tested for its phosphorus adsorptive

capability. In most gravel/sand borrow pits, material is water-lain and different beds have a different composition. Thus, a truly representative sample from the working face of a pit must contain all horizons in proportionate amounts. Sampling is carried out by taking a channel sample from the top to the bottom of the face and the method of obtaining a representative sample is outlined in photos 1, 2 and 3.

In many pits it will be found that some faces are unsuitable because material may be too coarse to have a good phosphate removal capability. In this case it may be necessary to sample only the B horizon if sufficient material from this zone is available.

PHOTO 1



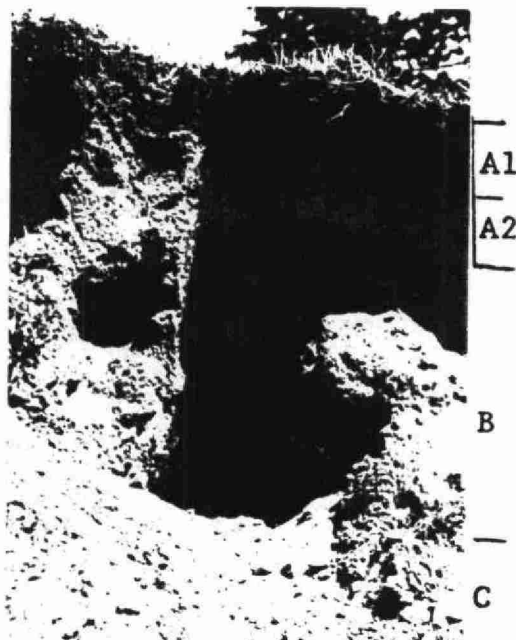
Channel Sample. The quarry face is first cleared and straightened. The sample is taken to cover the entire depth of the quarry working face, and is collected on a tarpaulin or plastic sheet.

PHOTO 2



The channel sample is quartered and two opposite quarters are thrown away. The remainder is mixed and the procedure is repeated until an appropriate sized sample is obtained to fill a 32 oz. width mouth sample jar.

PHOTO 3



Site of a channel sample. Note how the sloughed material at the base has been dug away to expose the face. The colour layers are interpreted as follows:

A1 Horizon-Horizon of maximum weathering and from which soluble minerals are removed by percolating waters.

A1-topsoil containing organic material
A2-leached zone from which soluble minerals are removed(not always apparent).

B Horizon-Horizon where materials such as clay and limonite leached from A zone are deposited. The result is that this zone commonly contains the finest material. This is at 1-2' depths in the test area.

C Horizon-Parent material. This is normally little altered by soil forming processes. See grey material at foot of channel

PHOTO 4



B

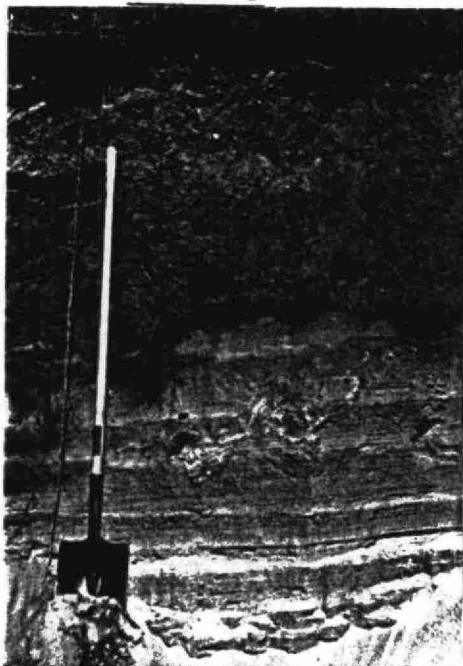
A Horizon - few inches topsoil above the picture.

C

B. Horizon - zone of deposition by percolating waters - light brown. Note the presence of swallow holes in the B Horizon (Sufficient fines to bind the soil so that nest will not be buried).

C Horizon - Unaltered zone. Note how the beds have truncated each other. This is typical of delta deposits.

PHOTO 5



A

A Horizon - Topsoil at top of photograph

B

B Horizon - Zone of deposition by percolating waters.

C

C Horizon - Unaffected by percolating water.

Note alfalfa root extending down some 6 feet on the left of the shovel. This type of growth has an appreciable effect on the permeability of soils.

PHOTO 6



Barr's Main Pit-Bob's Lake

The angle of repose of this material indicates that it contains a low percentage of fines.

Annex B to
Phosphorus Retention Capability
of Granular Soils on a Portion
of the Precambrian Shield

LAB PROCEDURES FOR PHOSPHATE ANALYSIS OF SOILS

RECORDS

Soil samples coming into the lab will be in 32 oz. wide-mouth glass jars, which hold approximately 1000 g. of soil. All samples are given a 4 digit number, the first digit indicating the year the sample was taken (i.e. 4001 - 1974, 5001 - 1975, etc.) and the remaining 3 digits left for chronological numbering of samples. The date, location (lake and owner's name) and depth of the sample are recorded as well as a description of the soil at the sampling site. Columns were also left in the record book for the percentage of material passing the #50 mesh and #200 mesh sieves, and for the samples' phosphorus adsorptive capability.

GRAIN SIZE DISTRIBUTION

Drying

The soil sample is emptied into 35 cm x 32 cm x 7 cm deep pan, labelled and allowed to dry at room temperature. Overnight is usually sufficient for a sandy soil weighing approximately 900g. If the sample has a high percentage of clay or silt then a longer drying time will be required. A drying oven is also available in the lab if needed. The maximum temperature for drying soil in the oven is 110°C; the desirable range being 80° - 90°C. If the drying oven is used, the sample should stand at room temperature for at least one hour to allow the soil to cool, and come to a constant weight (it will pick up moisture from the air).

Sieving

Once the sample is dried, approximately 500 g is weighed, ground gently with a rubber tipped pestle (the idea here is to break up lumps of soil but not crush any stones) and sieved. The weight of soil remaining on each individual sieve is then recorded. From this the grain size distribution can be calculated. When sieving, it is important that each sieve is checked to make sure that all lumps have been crushed and that no more material will pass that particular sieve. The latter is done by gently tapping the sieve on the bench top; using a piece of paper or thin cardboard to catch any particles that pass the sieve. This tapping procedure should be continued until no more material (or very small quantities) pass the sieve, and of course should be done for each sieve. When the sieving is completed, all the material that has passed the #50 mesh sieve is combined and put into a small labelled jar. This is the material that will be used for the phosphorus analysis.

Draw the best possible straight line through the points. The point where this line crosses the y axis is equal to $1/Q$. Solve for Q ($\frac{1}{\text{y-axis intersection}}$), which gives phosphorus removal in mg/g. Multiply by 100 to give gmg/100g, then multiply by the percentage of material used for the sample ($\frac{\text{percent used}}{100}$) to give phosphorus removal for the whole sample.

The calculations shown will give removal in terms of PO_4 . This result must be divided by 3 to give phosphorus removal in mg/g as P.

All 1975 results were obtained using a standard solution of 5 mg/l phosphorus as P. Redetermination of selected samples with 5 mg/l PO_4 solution (1.63 mg/l P) gave substantially the same results.

Sample 5095 is used as an example and the following steps are included:

- Sieve analysis
- Grain size distribution curve
- Laboratory calculations
- Graph

PHOSPHORUS ANALYSIS

Weighing

There may have been some gravity separation of the heavier particles (Fe rich particles) in the sieving process. Consequently the sample should be thoroughly mixed by stirring before the samples are weighed for phosphorus analyses.

Five samples of approximately 1, 2, 3, 5 and 7 grams of soil passing the #50 mesh are weighed accurately (using the analytical balance) into 250 ml erlenmyer flasks. 150 mls of a standardized 5 mg/l PO_4 solution is added to each flask. The flasks are stoppered and shaken for 24 hours. After the 24 hours, the samples should stand for at least 1 hour (longer does no harm) then filter through Whatman No. 3 or Reeve Angel 934AH glass fibre filter papers, with the glass fiber filter on top. Then the filtrate is filtered through a .45 micron millipore filter and analyzed for PO_4 . A 500 ml filtering flask and 10 cm Buchner funnel were used for the first filtering, and the same filtering flask with a millipore filter funnel for the second filtering, with the final filtrate being stored in 6 oz. bottles. All equipment and bottles used for the filtering process must be clean and rinsed with distilled water, then rinsed with a small portion of the sample being filtered.

PHOSPHORUS SOLUTION

The standard 5 mg/l PO_4 solution was standardized on the auto-analyzer. This solution is made as follows:

A 200 mg/l stock solution is made by dissolving .879 g. KH_2PO_4 in 1 litre of distilled water. 50 ml's of this solution is then pipetted into a 2 litre volumetric flask and made up to the mark with distilled water.

Calculations

x = wt. PO_4 retained
 = concentration of PO_4 standard, minus the concentration of PO_4 solution after 24 hours, multiplied by .15

x = $((\text{PO}_4 \text{ initial}) - (\text{PO}_4 \text{ final})) \times .15$

M = weight of soil

C_e = equilibrium of final PO_4 concentration

Q = x/M = (max. phosphorus removal in mg/g)

Plot $1/C_e$ on the x axis

Plot M/x on the y axis

SITE *Hern's Pit*
 SAMPLE No. *5095*
 BORE HOLE No.
 DEPTH *18'*
 Date *July 30, 1975*

SOIL TESTING

Name: *Bob's Lumber*

SIEVE ANALYSIS

Sieve Analysis dry ☒ Largest grain
 Sieve Analysis wet ☐ Total Weight W = *519.0 gm.*
 Sieve & Triometer Analysis ☐

Sieve No.	wt. retained gms. on sieve	accumulated	wt. retained %	wt. passing %
3"				
1 1/2"				
2"				
3/4"				
No. 4	<i>1.9</i>	<i>1.9</i>	<i>.37</i>	<i>100.00</i>
No. 8	<i>15.6</i>	<i>17.5</i>	<i>3.06</i>	<i>99.63</i>
No. 16	<i>41.1</i>	<i>58.6</i>	<i>8.08</i>	<i>96.57</i>
No. 30	<i>86.6</i>	<i>147.2</i>	<i>17.43</i>	<i>88.49</i>
No. 50	<i>157.3</i>	<i>304.5</i>	<i>30.95</i>	<i>71.06</i>
No. 100	<i>126.2</i>	<i>430.7</i>	<i>24.83</i>	<i>40.11</i>
No. 200	<i>50.9</i>	<i>481.6</i>	<i>10.01</i>	<i>15.28</i>
passing No. 200	<i>26.8</i>	<i>508.4</i>	<i>5.27</i>	<i>5.27</i>
Sum:	<i>508.4</i>		<i>100.00</i>	
Sieve Loss				

Remarks:

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT

SAND

GRAVEL

Fine

Medium

Coarse

Fine

Coarse

DEPARTMENT SIEVE DESIGNATION

270 200 140 100 60 50 40 30 20 16 10 8 4 3/4 1/2 3/8 1/4 1/8 3/16 1/32 3/64 1/128 1/256 1/512 1/1024 1/2048 1/4096 1/8192 1/16384 1/32768 1/65536 1/131072 1/262144 1/524288 1/1048576 1/2097152 1/4194304 1/8388608 1/16777216 1/33554432 1/67108864 1/134217728 1/268435456 1/536870912 1/1073741824 1/2147483648 1/4294967296 1/8589934592 1/17179869184 1/34359738368 1/68719476736 1/137438953472 1/274877906944 1/549755813888 1/1099511627776 1/2199023255552 1/4398046511104 1/8796093022208 1/17592186044416 1/35184372088832 1/70368744177664 1/140737488355328 1/281474976710656 1/562949953421312 1/1125899906842624 1/2251799813685248 1/4503599627370496 1/9007199254740992 1/18014398509481984 1/36028797018963968 1/72057594037927936 1/144115188075855872 1/288230376151711744 1/576460752303423488 1/1152921504606846976 1/2305843009213693952 1/4611686018427387904 1/9223372036854775808 1/18446744073709551616 1/36893488147419103232 1/73786976294838206464 1/147573952589676412928 1/295147905179352825856 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Aug. 12 # 5095
M = weight of soilMaterial passing 50.
(40.1%)

$$\begin{array}{r} \textcircled{1} \ 32.7029 \\ 31.6362 \\ \hline 1.0667 \end{array}$$

$$\begin{array}{r} \textcircled{2} \ 33.6421 \\ 31.6361 \\ \hline 2.0060 \end{array}$$

$$\begin{array}{r} \textcircled{3} \ 34.6853 \\ 31.6370 \\ \hline 3.0483 \end{array}$$

$$\begin{array}{r} \textcircled{5} \ 36.6619 \\ 31.6374 \\ \hline 5.0245 \end{array}$$

$$\begin{array}{r} \textcircled{7} \ 38.6979 \\ 31.6376 \\ \hline 7.0603 \end{array}$$

Sol'n # 25

$\bar{x}$	$\frac{M}{\bar{x}}$	$\frac{1}{\bar{x}}$
1) $(5.15 - 3.70) \times .15 = .218$	4.89	.270
2) $(5.15 - 3.30) \times .15 = .278$	7.22	.303
3) $(5.15 - 2.90) \times .15 = .338$	9.02	.345
5) $(5.15 - 1.40) \times .15 = .563$	8.92	.714
7) $(5.15 - .76) \times .15 = .659$	10.71	1.32

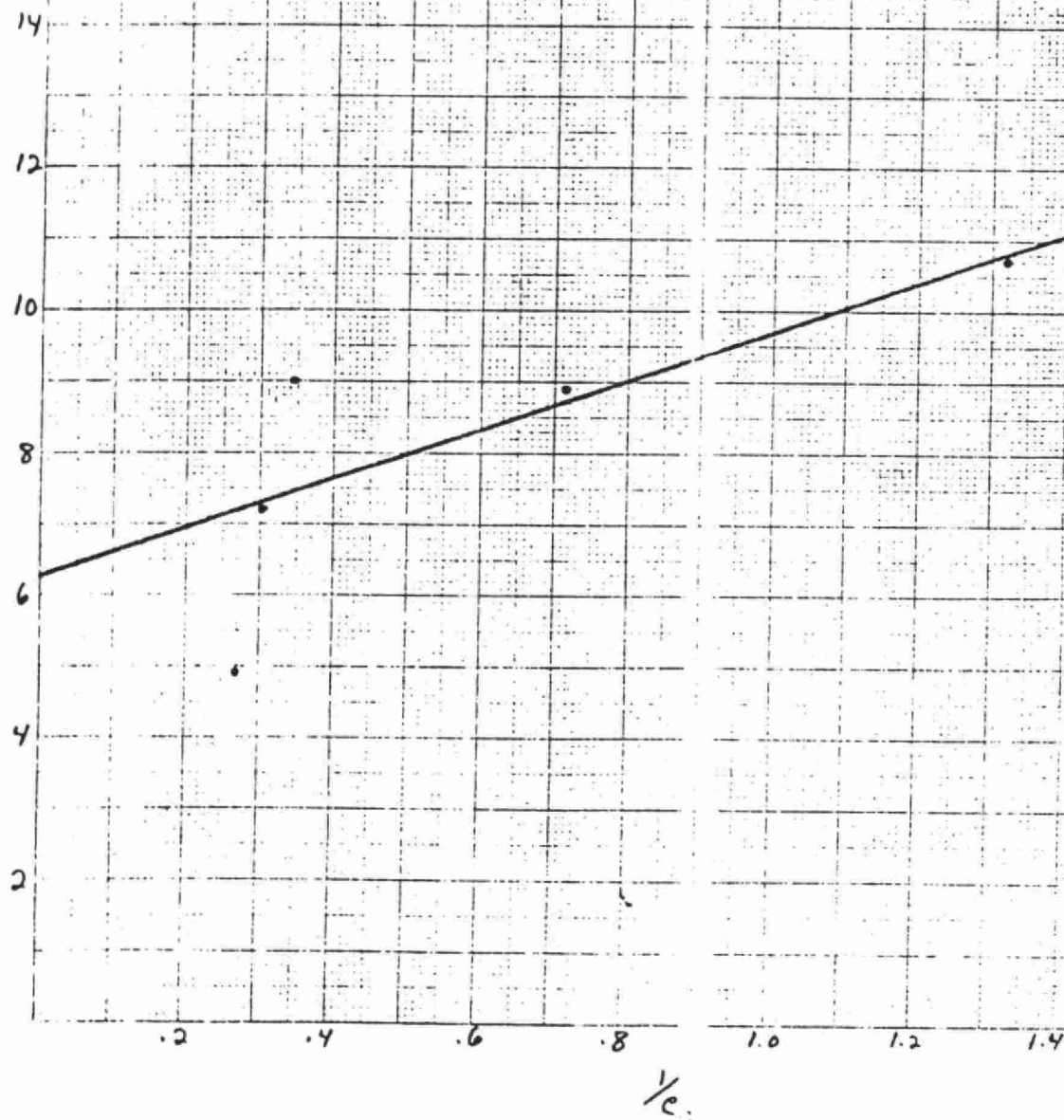
$$\bar{Q} = 6.3, \quad Q = .1587 \text{ mg/g}$$

$$.1587 \text{ mg/g} \times 100 = 15.87 \text{ mg/100g passing \# 50}$$

$$15.87 \text{ mg/100g} \times .401 = 6.36 \text{ mg/100g Sample}$$

fair graph, 3 points on.

P adsorption = 6.36 mg/100g



Annex C to Phosphorus
Retention Capability of
Granular Soils on a Portion
of the Precambrian Shield

SOIL SAMPLES TAKEN IN 1974

Sample No.	Lake	Location of Sample	Soil Description (See Notes 1 to Annex D)	% Passing 50 Mesh	% Passing 200 Mesh	P Retention Mg/100g	Remarks (See note 3) to Annex D)
4001	Sharbot	Noel Subd. Lot 18	Clay & silt, traces of fine sand	99	87	16.67	P 200 M
4002	Sharbot	Noel Subd. Lot 14	Fine sand & silt, trace of clay	98	76	3.90	P 200 M
4003	Sharbot	Noel Subd. Lot 14	Fine to coarse sand & some silt	18	10	1.61	P 200 M
4004	Sharbot	Noel Subd. Lot 10	Black organic silty sand, some gravel, traces of clay	55	31	30.9	P 200 M
4005	Christie	Borrow Pit S. Sherbrooke Channel Sample	Fine to Coarse Sand some silt	53	4	4.53	P 200 M
4006	Sharbot	Baker's Pit Hawley Bay Channel Sample	Fine to Coarse Sand, Traces of Gravel	84	20	7.24	P 200 M

Sample No.	Lake	Location of Sample	Soil Description (See Notes 1 to Annex D)	% Passing 50 Mesh	% Passing 200 Mesh	P Retention Mg/100g	Remarks (See note 3) to Annex D
4007	Sharbot	Cox's Pit (West Pit) Channel Sample	Fine to coarse sand some silt traces of fine gravel	66	21	6.78	P 200 M
4008	Ontario	Outlet Beach Prince Edward Co.	Fine sand	99	0	negligible	P 200 M
4009	Ontario	Borrow Pit Hallowell Tp. Prince Edward Channel Sample	Fine to Medium Sand	64	8	3.72	P 200 M
4010	Bobs	Hern's Pit Buck Bay Channel Sample	Fine to Coarse Sand, traces of gravel & silt	44	6	2.37	P 200 M
4011	Bobs	Borrow Pit Boling broke Channel Sample	Fine to coarse sand, traces of gravel & silt	26	6	1.5	P 200 M
4012	Bobs	Borrow Pit (Burns Pond) Channel Sample	Fine to coarse sand, some silt traces of gravel	41	15	1.43	P 200 M
4013	Misc. (Silver)	Borrow Pit N. Sherbrooke Tp., Channel Sample	Fine to Coarse sand, traces of gravel & silt	18	3	.63	P 200 M

Sample No.	Lake	Location of Sample	Soil Description (See Notes 1 to Annex D)	% Passing 50 Mesh	% Passing 200 Mesh	P Retention Mg/100g	Remarks (See note 3) to Annex D
4014	Steenburg	Mosson's Pit depth 2'	Fine to coarse sand, some silt traces of gravel	41	16	21.8	P 200 M
4015	Steenburg	Mosson's Pit depth 6'	Fine to coarse sand, traces of silt & fine gravel	35	4	Negligible	P 200 M
4016	Steenburg	Mosson's Pit depth 2'	Fine to medium sand, some silt	87	12	40.5	P 200 M
4017	Steenburg	Tile bed - trailer park depth 1'	Fine to coarse silty sand, trace of gravel & clay	65	36	45.0	P 200 M
4018	Big Rideau	Severance	Organic silt & sand trace of clay & fine gravel	85	62	50.1	P 200 M
4019	Big Rideau	Severance	Silt & clay some fine to medium sand	97	83	22.1	P 200 M
4020	Big Rideau	Severance	Black organic fine to coarse sand & gravel some silt	21	12	4.60	P 200 M

Sample No.	Lake	Location of Sample	Soil Description (See Notes 1) to Annex D)	% Passing 50 Mesh	% Passing 200 Mesh	P Retention Mg/100g	Remarks (See note 3) to Annex D
4021	Little Silver	Noel Subd. Lot 1	Silty sand, some fine gravel traces of clay	65	33	7.84	P 200 M
4022	Little Silver	Noel Subd. Lot 4	Organic silty sand, traces of fine gravel & clay	69	30	47.1	P 200 M
4023	Little Silver	Noel Subd. Lot 14	Organic fine to coarse sand & silt, traces of clay & fine gravel	73	42	16.42	P 200 M
4024	Little Silver	Noel Subd. Access Rd. Borrow Pit Depth 2'	Fine to coarse sand, some silt & fine gravel, traces of clay	58	20	34.7	P 200 M
4025	Little Silver	Noel Subd. Access Rd. Borrow Pit Depth 3'	Fine to coarse sand, some gravel, traces of silt	47	8	12.5	P 200 M

SOIL TESTS CONDUCTED IN 1975

Sample No.	Lake	Location of Sample	Soil Description (See Notes 1 & 2)	% Passing 50 Mesh	% Passing 200 Mesh	P Retention Mg/100g	Remarks (See Note 3)
5002	Steenburg	Steenburg Lodge Trailer Park, Depth 1' 200' NW of tile bed	Sandy silt & clay	92	69	36.12	P 200 M
5003	Steenburg	Steenburg Lodge trailer park, depth 1' 200' E of tile bed	Sand & silt/clay with a trace of gravel	77	45	19.43	P 200 M
5004	Steenburg	Mosson's Pit Depth 14"-18"	Sand with some gravel & silt/clay	23	17	7.50	P 200 M
5006	Steenburg	Mosson's Pit Channel Sample over 15'5"	Medium sand with traces of gravel & silt	21	3.3	1.40	P 200 M
5011	Sharbot	Baker's Pit Channel Sample over 6 ft.	Fine to medium Sand with traces of gravel & silt	61	10	4.59	P 50 M
5013	Sharbot	Cox Pit Channel Sample over 6'8"	Sand with some gravel & traces of silt	31	4	1.00	P 50 M

Sample No.	Lake	Location of Sample	Soil Description (See Notes 1 & 2)	% Passing 50 Mesh	% Passing 200 Mesh	P Retention Mg/100g	Remarks (See Note 3)
5015	Sharbot	Cox Pit Depth 2'	Fine to medium sand, some silt/clay	77	21	9.20	P 200 M
5016	Bobs	Housing T-23813/14 Dyer Subd. Lot 6, Depth 12"-14"	Sand with some silt/clay & gravel	42	15	14.19	P 200 M
5017	Bobs	Dyer Subd Lot 9, Depth 14" - 18"	Sand with some silt/clay & gravel	54	18	5.52 5.58 11.10	P 200 M R 100 & 200 M P 50 M
5019	Bobs	Dyer Subd. Lot 5, Depth 12"-14"	Silty (clay) sand with of gravel	70	33	18.44	P 200 M
5022	Bobs	Dyer Subd. Lot 16 Depth 12"	Silty (clay) with some gravel	58	29	16.28	P 200 M
5023	Bobs	Dyer Subd. Lot 37	Sand with some silt/clay & trace of gravel	50	15	3.69 5.23 8.92	P 200 M R 100 & 200 M P 50 M

Sample No.	Lake	Location of Sample	Soil Description (See Notes 1 & 2)	% Passing 50 Mesh	% Passing 200 Mesh	P Retention Mg/100g	Remarks (See Note 3)
5024	Bobs	Dyer Subd. Lot 28 Depth 10"	Medium to fine sand with some silt/clay & traces of gravel	57	28	12.08	P 200 M
5025	Bobs	Dyer Subd. Lot 7 Depth 12"	Medium to fine sand with some silt/clay & traces of gravel	60	29	14.38	P 200 M
5027	Sharbot	Housing # T 24765 Noel Subd. Recce. for tile bed material channel over 45"	Sand with some silt & gravel	41	13	2.96	P 200 M
5028	Sharbot	Moss Pit North Depth 1'	Fine sand some silt/clay	96	16	3.17 3.35 <u>6.52</u>	P 200 M R 100 & 200 M <u>P 50 M</u>
5029	Sharbot	Moss Pit Central Depth 1'	Sand with traces of silt & gravel	34	5	2.30 1.29 <u>3.59</u>	P 200 M R 100 & 200 M <u>P 50 M</u>

Sample No.	Lake	Location of Sample	Soil Description (See Notes 1 & 2)	% Passing 50 Mesh	% Passing 200 Mesh	P Retention Mg/100g	Remarks (See Note 3)
5030	Sharbot	Moss Pit between Central & S. Pit, depth 1'	Fine sand with some silt/clay	90	25	6.62 4.01 <u>10.63</u>	P 200 M R 100 & 200 M <u>P 50 M</u>
5031	Sharbot	Noel Subd. Recce. for tile bed material Depth 32"	Sand with some silt/clay & gravel	50	19	10.21	P 200 M
5032	Sharbot	Noel Subd. Recce. for tile bed Depth 18"	Sand with some silt/clay & gravel	42	13	2.69	P 200 M
5033	Sharbot	Noel Subd. Recce. for tile bed material depth 31"	Sand with some silt/clay & gravel	57	26	9.51	P 200 M
5034	Sharbot	Noel Subd. Recce. for tile bed material Depth 50"	Sand with some silt/clay & gravel	40	13	3.35 7.66 <u>11.01</u>	P 200 M R 100 & 200 M <u>P 50 M</u>

Sample No.	Lake	Location of Sample	Soil Description (See Notes 1 & 2)	% Passing 50 Mesh	% Passing 200 Mesh	P Retention Mg/100g	Remarks (See Note 3)
5035	Sharbot	Noel Subd. Recce. for tile bed material channel sample to 3'	Silty sand with trace of gravel	53	30	8.18 4.49 <u>12.67</u>	P 200 M R 100 & 200 M <u>P 50 M</u>
5036	Sharbot	Noel Subd. Recce for tile bed material Depth 44"	Sand with some silt/clay & a trace of gravel	54	21	4.90 7.94 <u>12.84</u>	P 200 M R 100 & 200 M <u>P 50 M</u>
5037	Bobs	Carson Subd. Lot 4 12" depth	Sand with some silty/clay & gravel	52	22	3.96 9.68+	P 200 M P 50 M
5038	Bobs	Carson Subd. Lot 14 12" depth	Silty sand with some gravel	62	39	8.77	P 200 M
5039	Bobs	Orton Dev. Depth 2'	Sand with a trace of silt & gravel	36	7	8.27	P 50 M
5040	Bobs	Orton Dev. Depth 2'	Sand with a trace of silt	51	9	3.55 5.35 <u>8.90</u>	P 200 M R 100 & 200 M <u>P 50 M</u>

Sample No.	Lake	Location of Sample	Soil Description (See Notes 1 & 2)	% Passing 50 Mesh	% Passing 200 Mesh	P Retention Mg/100g	Remarks (See Note 3)
5042	Bobs	Orton Dev. Depth 2'	Sand with a trace of silt & gravel	50	8	7.36	P 50 M
5046	Bobs	Orton's Pit Glacial till	Silty sand with a trace of gravel & boulders	72	35	9.89	P 200 M
5047	Bobs	Barrs Pit Channel Sample 7'5"	Fine to medium sand with a trace of silt & gravel	37	3	3.45	P 50 M
5049	Bobs	Barr's Pit Channel over 7'	Fine to medium sand with a trace of silt	53	4	6.24	P 50 M
5053	Bobs	Hern's Pit Depth 2'	Sand with traces of silt/clay & gravel	48	9	2.54 2.45 <u>4.61</u>	P 200 M R 100 & 200 M P 50 M
5056	Bobs	Hern's Pit Channel over 4'4"	Sand with traces of silt/clay & gravel	49	9	3.55	P 50 M

Sample No.	Lake	Location of Sample	Soil Description (See Notes 1 & 2)	% Passing 50 Mesh	% Passing 200 Mesh	P Retention Mg/100g	Remarks (See Note 3)
5061	Sharbot	Noel Subd. Recce. for tile bed material Channel over 57"	Sand with some clay/silt & a trace of gravel	39	13	8.32	P 50 M
5062	Sharbot	Noel Subd. Recce. for tile bed material Channel over 60"	Sand with some clay/silt & trace of gravel	43	17	11.49	P 50 M
5064	Sharbot	Noel Subd. Recce. for tile bed material Channel over 3'	Sand & silt /clay with a trace of gravel	81	40	6.75	P 200 M
5065	Sharbot	Noel Subd. Recce. for tile bed material Depth 18"	Sand with some silt/clay & a trace of gravel	50	12	3.20 6.05 <u>9.25</u>	P 200 M R 100 & 200 M <u>P 50 M</u>

Sample No.	Lake	Location of Sample	Soil Description (See Notes 1 & 2)	% Passing 50 Mesh	% Passing 200 Mesh	P Retention Mg/100g	Remarks (See Note 3)
5066	Sharbot	Noel Subd. Recce. for tile bed material Depth 3'	sand with some silt/clay & gravel	43	20	3.35 0.00 <u>3.35</u>	P 200 M R 100 & 200 M <u>P 50 M</u>
5067	Sharbot	Noel Subd. Recce. for tile bed material Depth 18"	Sand with some silt/clay & gravel	50	23	5.35 2.79 <u>8.14</u>	P 200 M R 100 & 200 M <u>P 50 M</u>
5068	Sharbot	Noel Subd. Recce. for tile bed material Depth 36"	Sand with some silt/clay & gravel	46	13	2.44 0.00 <u>2.44</u>	P 200 M R 100 & 200 M <u>P 50 M</u>
5069	Trout	Camp Bevaline Depth 30"	Medium sand with a trace of silt/clay	45	6	6.37	P 50 M
5070	Trout	Camp Bevaline Depth 31"	Medium sand with a trace of silt/clay	19	4	6.34	P 50 M

Sample No.	Lake	Location of Sample	Soil Description (See Notes 1 & 2)	% Passing 50 Mesh	% Passing 200 Mesh	P Retention Mg/100g	Remarks (See Note 3)
5074	Sharbot	Moss Pit North Depth 1'	Fine to medium sand with some silt/clay & a trace of gravel	71	13	17.75	P 50 M
5077	Sharbot	Moss Pit North Channel over 90"	Fine to Medium sand with some silt/clay	65	12	9.03	P 50 M
5078	Sharbot	Moss Pit Depth 1'	Fine to Medium sand with some silty/clay	63	13	11.5	P 50 M
5080	Sharbot	Oconto Pit Channel over 62"	Fine sand with some silt/clay	88	19	2.50 2.88 <u>5.38</u>	P 100 M R 100 M <u>P 50 M</u>
5081	Sharbot	Oconto Pit Channel over 40"	Fine sand with some silt/clay	91	16	10.81	P 50 M
5082	Sharbot	Oconto Pit 2' Depth	Sand with traces of silt & gravel	45	7	7.87	P 50 M

Sample No.	Lake	Location of Sample	Soil Description (See notes 1 & 2)	% Passing 50 Mesh	% Passing 200 Mesh	P Retention Mg/100g	Remarks (See Note 3)
5087	Bobs	Barr's Pit (Main) 2' Depth	Fine sand with a trace of silt/clay	62	5	4.96	P 50 M
5088	Bobs	Barr's Pit (Back) 3' depth	Sand with traces of silt/clay & gravel	51	5	7.42	P 50 M
5089	Bobs	Barr's Pit (Back) 18" depth	Fine sand with traces of silt/clay	51	5	4.90 4.58 <u>9.48</u>	P 100 M R 100 M <u>P 50 M</u>
5090	Bobs	Barr's Pit (Back) 18" depth	Fine to Medium sand with some silt/clay	65	12	3.99 2.87 <u>6.86</u>	P 100 M R 100 M <u>P 50 M</u>
5091	Bobs	Dyer's Pit Depth 2'	Fine to Medium sand with some silt/clay & traces of gravel	77	11	3.95 4.44 <u>8.39</u>	P 100 M R 100 M <u>P 50 M</u>
5092	Bobs	Dyer's Pit Depth 18"	Fine to medium sand with traces of silt/clay & gravel	53	7	3.45	P 50 M

Sample No.	Lake	Location of Sample	Soil Description (See notes 1 & 2)	% Passing 50 Mesh	% Passing 200 Mesh	P Retention Mg/100g	Remarks (See note 3)
5093	Bob's	Hern's Pit Back field 4" depth	Fine to medium sand with some silt/clay	66	12	7.07	P 50 M
5094	Bobs	Hern's Pit Back field 18" depth	Fine to medium sand with some silt/clay & a trace of gravel	72	12	5.87 6.61 <u>12.48</u>	P 100 M R 100 M <u>P 50 M</u>
5095	Bobs	Hern's Pit Back field 18" depth	Sand with a trace of silt/clay	40	5	6.36	P 50 M
5096	Troy Twp. of S. Crosby	Housing # T 23468 Linscott Subd. Lot 14 Depth 2'	Sand and silt/clay	65	41	22.70	P 50 M
5097	Troy	Linscott Subd. Lot 10 Depth 2'	Fine to medium sand with a trace of silt	66	6	7.82	P 50 M

NOTES

1. Naming of Soils - Soils have been described in accordance with the Interim Handbook for Private Sewage Disposal Systems:
 - (a) Describe soils as boulders, gravel, sand, silt, or clay.
If there is greater than 40% of a second size, use "and" i.e. sand and gravel (major constituent sand).
 - (b) If there is a component with greater than 25%, use adjective i.e. gravelly sand.
 - (c) If there is a component between 10 and 25%, use "some" - i.e. sand with some gravel.
 - (d) If there is a component between 1 and 10%, use "with traces of", i.e. sand with traces of gravel. It is possible to use different combinations to describe a soil - i.e. sand and gravel with traces of silt.
2. Time did not permit hydrometer tests to distinguish between silt and clay.
3. Earlier tests for P retention were run on the 200 mesh fraction. However, because of the high proportion of material passing 50 mesh in many samples, it was found that this portion had a significant phosphate adsorptive capability. In most cases where the fraction passing 50 mesh was large, tests were later run on the material retained on 100 and 200 mesh screens and this was added to the test results obtained on the material passing 200 mesh.

Results are coded as follows:

P 50 M - retention based on sample passing 50 mesh

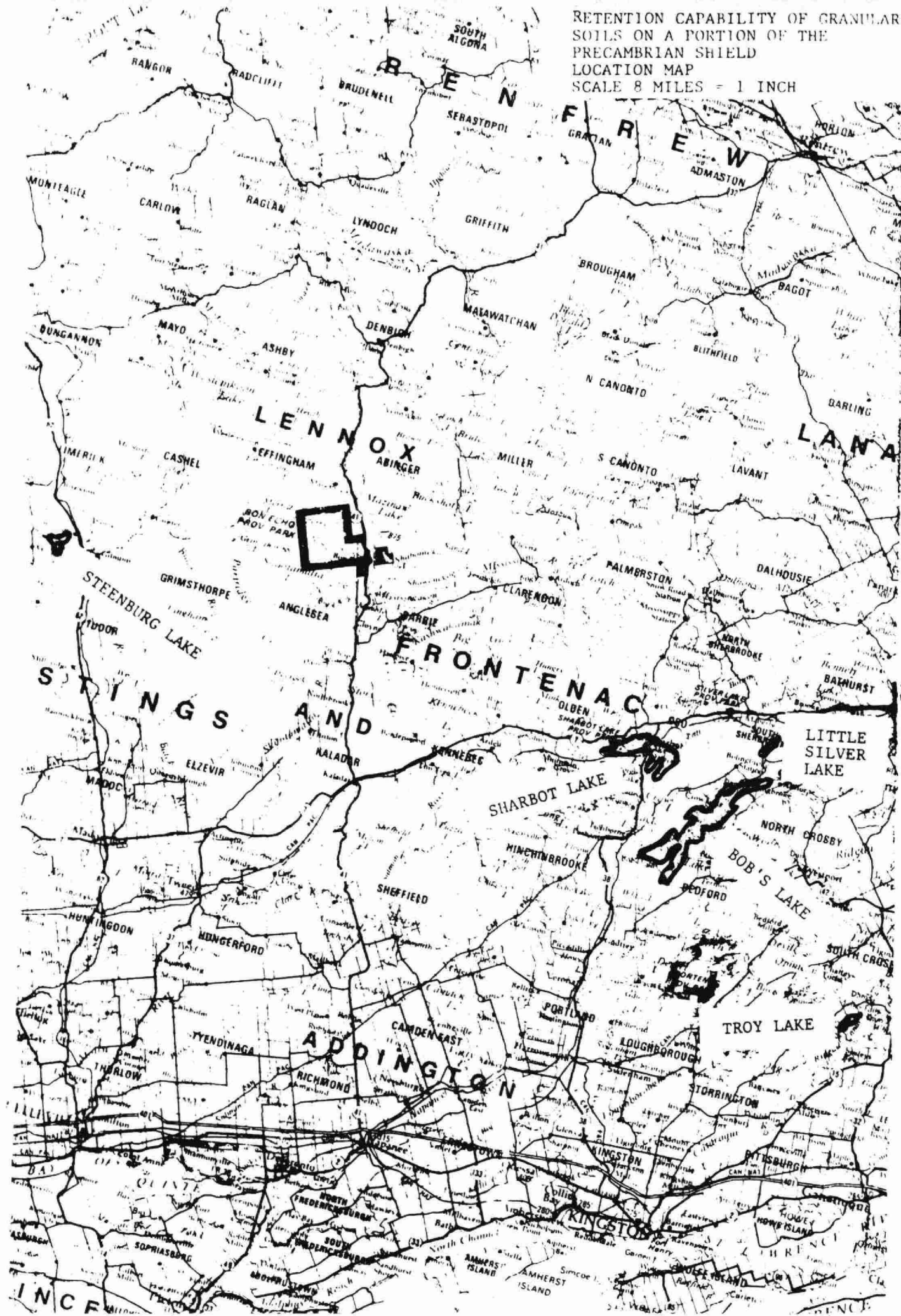
P 100 M - P retention based on sample passing 100 mesh

P 200 M - P retention based on sample passing 200 mesh

R 100 & R 200 M + P 200 M = P 50 M

P 100 M + R 100 M = P 50 M

RETENTION CAPABILITY OF GRANULAR
SOILS ON A PORTION OF THE
PRECAMBRIAN SHIELD
LOCATION MAP
SCALE 8 MILES = 1 INCH





[illegible]

MOE/PHO/AOIF
Aitkens, D F
Phosphorus retention
capability of granular soils aoif
on a portion of the precambrian
shield C.1 a aa



(12047)
MOE/PHO/AOIF